ILLINOIS BUSINESS REVIEW

A MONTHLY SUMMARY OF BUSINESS CONDITIONS FOR ILLINOIS

PUBLISHED BY . . . .
BUREAU OF ECONOMIC AND BUSINESS RESEARCH
COLLEGE OF COMMERCE · UNIVERSITY OF ILLINOIS

VOLUME XIII | NOVEMBER, 1956 | NUMBER 11

HIGHLIGHTS OF BUSINESS IN OCTOBER

Industrial production expanded in October as steel output continued to exceed rated capacity and automobile assembly lines resumed production. The Federal Reserve Board index of industrial production for the month may have exceeded the September level of 144 (1947-49 = 100).

Department store sales in October were below the high level of the third quarter on a seasonally adjusted basis. The adjusted index dropped to 123 (1947-49 = 100) from 129 in September.

Auto Output Short of Goal

Automobile production in October climbed to 389,000 units following the completion of model changeovers by all makes except Packard. This total was far short of the predicted 500,000 and of the 518,000 produced last October. Production difficulties — strikes, parts shortages, and others — accounted for the decline.

Little Change in Employment

Seasonal increases carried employment to a record total for October of 66,174,000, up 103,000 from September. By mid-October, unemployment had fallen to 1,909,000, down 89,000 from mid-September. With only 2.8 percent of all civilian workers out of jobs, the October unemployment rate was as low as in any month during the past three years.

Construction Declines Seasonally

Outlays for new construction totaled $4.1 billion in October, $200 million below September, but $100 million above October a year ago. It was the second consecutive monthly decline and was largely seasonal in character. Most of the decrease in private construction resulted from the more-than-seasonal reduction in the value of work put in place on new private housing. This category was 14 percent below the October record of 1955, whereas other major private construction categories continued at high levels.

Public construction was down slightly from the September level, but was above that of October, 1955. During the first 10 months of this year public construction outlays ran 7 percent above those of the corresponding 1955 period, whereas private construction remained at about the same level as last year.

Personal Income Rises Slightly

Personal income reached an annual rate of $328.5 billion in September, $400 million above the annual rate for August and $17.5 billion above that for September, 1955. The increase over the August level was only one-tenth as large as the rise from July to August.

Higher wage and salary income accounted for all of the increase over the previous month, although the payroll gains were smaller than in most other months this year.

Consumer Debt Rise Off

September saw a sharp decline in the rate of increase in consumer installment debt. Only $60 million was added to the total, compared with $350 million in August and $500 million in September, 1955. Most of the increase came in personal loans and in repair and modernization loans. With potential customers waiting for the new models, expansion of outstanding automobile installment credit, which has been a major element in the growth of consumer debt in earlier months, came to a virtual halt as repayments almost offset new credit granted. Additions to outstanding credit for other consumer durables were also negligible.

Manufacturers' Stocks Up, Sales Level

Inventory book values of manufacturers had climbed to $49.6 billion at the end of September, $500 million above the August level after seasonal adjustment and $5.3 billion above that of September, 1955. The increase over August was confined largely to the durable-goods sector, where inventories had been affected in July and August by the steel strike. It was the same as the average monthly increase during the first six months of the year.

Manufacturers' sales of $27.7 billion were equal to those of August after seasonal adjustment and were only $100 million above the total for September, 1955. The stock-sales ratio for manufacturing reached 1.8 compared with 1.6 a year ago. New orders were down $900 million from the August level and $500 million from that of the previous September. However, unfilled orders, of which more than 95 percent were in the durable-goods industries, were $500 million above those of August and $10 billion above those of a year ago.

AN APPRAISAL OF OPERATIONS RESEARCH TECHNIQUES · By J. W. Petersen · Page 6

ILLINOIS BUSINESS REVIEW

Published monthly by the

BUREAU OF ECONOMIC AND BUSINESS RESEARCH
UNIVERSITY OF ILLINOIS

The material appearing in the *Illinois Business Review* is derived from various primary sources and compiled by the Bureau of Economic and Business Research. Its chief purpose is to provide businessmen of the State and other interested persons with current information on business conditions. The *Review* will be sent free on request.

Entered as second-class matter February 5, 1944, at the post office at Urbana, Illinois, under the Act of August 24, 1912.

V LEWIS BASSIE, *Director* — RUTH A. BIRDZELL, *Editor of Publications*

JOSEPH D. PHILLIPS, *Research Associate Professor*

Research Assistants

ANN ALVORD — PATRICIA P. WEBBER
DAVID J. BLOMBERG — DONALD C. STREEVER, JR.

Innovation Rules the Boom

At the peak of prosperity, after a long series of gains with only minor interruptions, attention tends to be focused on the factors underlying economic growth. Among those factors are increased industrial efficiency and the inventive genius of those who have developed new products and new techniques for making products of all kinds. There are, for the time being, so many things to do and so many ways of doing them that fears of idleness seem entirely unwarranted: If there should be a slackening anywhere, surely something else would take its place.

Currently, the scientific and technical research which contributes most of the new developments is progressing at an unprecedented rate. Corporate research and development expenditures are estimated at over $4 billion a year. Large corporations are estimated to spend an average of 2 percent of sales for research, with expenditures in such industries as aircraft, radio-television, and electrical equipment running to well over 5 percent.

Stability of Research Expenditures

Research exerts its economic effects largely through subsequent business investment in new plant and equipment. Facilities are needed to turn out the new products and to take advantage of the new processes; and even where there is nothing strikingly new or different in either, the new plants usually incorporate various improvements and increase over-all capacity to produce.

Since research is currently running at a peak, it seems to many that new discoveries must constantly call for a correspondingly high level of investment. No one questions that the rate of innovation has been a factor in the investment boom of the past year. But when this line of thinking is carried to the point of stating that research and investment will remain at peak levels indefinitely, it drifts into the realm of economic fallacy.

In the first place, there can be no assurance that research will continue at present levels if adverse business conditions develop. In the early 1930's, research programs were cut drastically, perhaps more rapidly in the aggregate than the over-all decline in business. It is said that business now better recognizes its dependence upon research and will not make the same mistake again. This point may have some merit, but it does not completely override the tendency of many businesses to regard research as a luxury, to be undertaken when profits are high and curtailed when they have fallen back. This "hard-headed" view is justified by the fact that research contributes no immediate return, but only the prospect of an improved future.

Today, a large portion of total research expenditures are financed by the Federal government — either directly through research contracts or indirectly through tax reductions. The government is spending over $2 billion a year on research and development, with perhaps something over half being channeled through corporations. Of the remaining $3 billion of corporate expenditures, roughly half may also be regarded as being paid for by the government, since research expense is deductible and earnings are taxed at 52 percent. This logic holds, however, only so long as there are such substantial earnings as to leave adequate funds available after taxes for other corporate purposes. When earnings are squeezed, research becomes competitive with other corporate needs, including dividends; and in the struggle for available funds, it can hardly be considered dependably stable.

Discovery and Innovation

Even if one chooses to regard research as a relatively stable element in the business picture, the tie between discovery and investment is not so close as to ensure that the latter will consistently follow the former. The business cycle analyst who has made the most thorough study of innovations — J. A. Schumpeter — found that their pace is not governed by that of invention. The inventor's discoveries create opportunities for new investments. They cannot ensure that investments will actually be undertaken to give them immediate practical application. Knowledge may lie dormant through years of depression. Then, the concerted rush to apply it generates the succeeding boom.

Schumpeter's studies of innovation produced a theory, not primarily of growth, but of business cycles. He saw the continuity of technological progress but was impressed by the way waves of expansion and contraction interrupted the pattern of steady growth. The practical innovators put accumulated knowledge to work in a frenzy of haste, and then, for a while, investment lagged while the basis for a new upsurge developed. He held these waves of innovation, or cycles in investment, to be inherent in the processes of adjustment in an economy like ours.

Although this type of theory does not offer a complete explanation, the thesis that investment is subject to wide cyclical fluctuations is widely accepted by other analysts. Rates of investment swell at times to heights that cannot be sustained. Then, after industry has exploited its plans for the best in new facilities, investment must drop back from the peak. The automobile industry is entering this stage in its investment cycle today, and its capital outlays may be declining for the next two or three years. No industry is exempt from a similar pattern of saturation in investment programs.

Productivity and Obsolescence

Some who look for current rates of investment to be sustained place the emphasis not upon growth in capacity but upon obsolescence. The older capacity is held to involve excessively high costs. Cost reductions in the new plants commonly take the form of laborsaving devices,

(Continued on page 8)

TRANSPORTATION CENTER OF THE WORLD

No other area in the world offers manufacturers and distributors the extensive transportation facilities that are available in Illinois. Endowed with an impressive system of waterways and equipped with an even greater network of railroads, highways, and airways, Illinois provides transportation for more people and for more tons of goods than any other state in the nation. Chicago has long been recognized as the country's transportation capital, and the new St. Lawrence Seaway Project has created the prospect of its becoming a major world port.

Railways

Illinois has 30 major railroads and 31 terminal, switching, belt, and interurban lines operating over 11,400 miles of track. The number of miles of track has declined from the high of 12,500 miles in 1930, but this steady decline is general throughout the United States and is due primarily to the introduction of better equipment, more efficient methods of routing, and the consolidation of facilities. In 1955 there were 108,530 railroad employees in Illinois with an annual payroll of $492.2 million — the largest number of railroad employees and the largest railroad payroll of any state in the nation.

Chicago is the largest rail terminal in the world, measured by volume of tonnage and extent of facilities. The Chicago Terminal District contains nearly 8,000 miles of track and covers 1,750 square miles, an area larger than the state of Rhode Island. Operating in this area are 37 railroads — 19 trunk lines, seven belt and switching companies, eight industrial railroads, and three electric interurban railroads. It is estimated that the CTD handles 17 percent of the nation's passenger business, and 7 percent and 4 percent respectively of freight car loadings and unloadings. All told, nearly 45,000 freight cars are handled there each day.

Motor Carriers

Illinois was rated fourth in the nation in motor truck registration in 1955, with a total of 407,501 trucks of all types, an increase of 172,987 since 1941. Trucking in Illinois is centered around Chicago, the hub of the nation's trucking industry. Approximately 500 intercity and interstate motor freight companies located in Chicago serve communities throughout the nation; in addition there are 2,000 local cartage companies in the city. The 247 trucking terminals located there offer specialized services to shippers far surpassing those of any other city.

Overnight delivery service is provided within a 400-mile radius of Chicago and 33-hour service to New York City is available. Many haulers also offer a four-day service to the West Coast. In all, there are some 34,000 communities throughout the 48 states which are provided with a direct, scheduled service from Chicago.

More than 100 bus lines operating over 14,800 miles of State highways connect virtually every city, town, and village in Illinois. Some 900 intercity and interstate buses carry an average of 10,000 passengers a day to Chicago alone. The new $10 million, ultramodern Chicago Greyhound Terminal provides facilities for 31 buses and is capable of dispatching 124 buses, with a capacity of 4,500 passengers, every hour.

Airways

Chicago is also served by 13 major airlines, 11 of which offer direct overseas services. In addition, three major "feeder-line" systems originate or terminate a large percentage of their flights in Chicago. Its facilities handle more planes, passengers, and cargo than any other city. In 1955, 8.6 million persons, approximately 25 percent of all the air travelers flown in the United States, utilized its services. This amounts to nearly 17 percent of the world's total air passenger travel.

Chicago's Midway Airport is the world's busiest. As many as 1,200 flights a day have been handled there and it normally averages 900 flights every 24 hours. Just northwest of the city is O'Hare Field, the world's largest airport. It covers an area of 10 square miles — 10 times that of Midway and 1,000 acres larger than New York's Idlewild. It is being brought into use gradually, with flights being systematically transferred in an effort to reduce the load at Midway. It is estimated that these two airports combined will handle 14.5 million passengers annually by 1960 and 22 million by 1970.

Illinois ranks third among the states in the number of civil aircraft and fourth in the number of active pilots. There are currently 3,515 registered aircraft and 10,549 registered pilots in Illinois as compared with 896 and 1,817 respectively in 1939. The number of commercial airports has also increased from 30 to 134 and private-use airports from three to 520 over the same period.

Waterways

Illinois waterways total 1,175 miles, consisting of 427 miles of navigable rivers and canals inside the State and 748 miles of natural waterway created by the bordering Mississippi and Ohio rivers. These rivers directly connect Illinois to the 15,000 miles of navigable channels of the Mississippi Waterway System whose water-borne commerce is nearly half again as large as that handled by the Panama Canal.

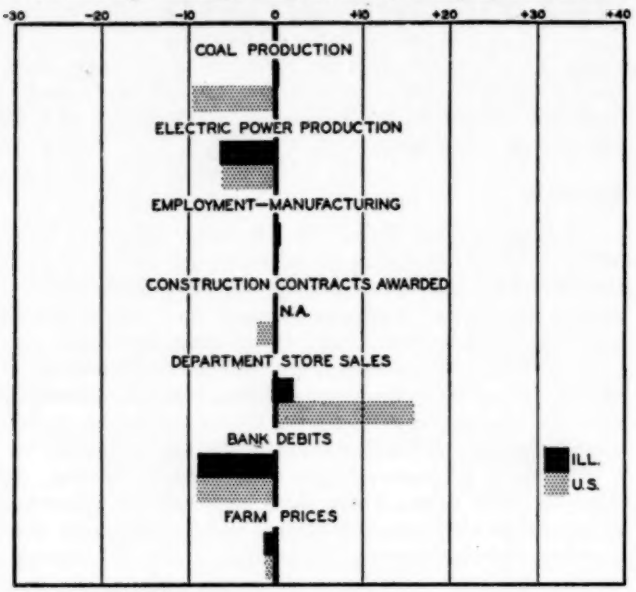
The Illinois Waterway (from Grafton on the Mississippi to Chicago) carried traffic amounting to more than 21 million tons in 1955 as compared with 5.5 million tons in 1939. Major commodities hauled included coal, petroleum, grain, sand, gravel, stone, and steel products.

Chicago has become a port of some importance. In 1955 it handled nearly 39 million tons of commerce, an increase of more than 7 million tons over the previous year, and was rated as the eighth largest port in the nation in terms of tonnage handled. It currently handles about 40 percent of all overseas tonnage in and out of the Great Lakes, and 254 overseas vessels — 90 percent of all ships engaged in Great Lakes overseas trade — made Chicago a port of call in 1955.

STATISTICAL SUMMARY OF BUSINESS ACTIVITY

SELECTED INDICATORS

Percentage changes August, 1956, to September, 1956



N.A. Not available.

ILLINOIS BUSINESS INDEXES

Item	Sept. 1956 (1947-49 =100)	Percentage Change from Aug. 1956	Percentage Change from Sept. 1955
Electric power[1]	203.9	−6.3	+ 0.1
Coal production[2]	77.3	+0.2	+ 4.2
Employment—manufacturing[3]	107.9	+0.4	+ 1.6
Weekly earnings—manufacturing[3]	148.7[a]	+1.0	+ 3.4
Dept. store sales in Chicago[4]	119.0[b]	0.0	+ 6.3
Consumer prices in Chicago[5]	120.3	+0.2	+ 1.2
Construction contracts awarded[6]	n.a.	.....	.....
Bank debits[7]	151.5	−8.9	− 4.2
Farm prices[8]	83.0	−1.2	+ 7.8
Life insurance sales (ordinary)[9]	211.1	−7.5	+18.0
Petroleum production[10]	129.9	−0.5	+ 2.1

[1] Fed. Power Comm.; [2] Ill. Dept. of Mines; [3] Ill. Dept. of Labor; [4] Fed. Res. Bank, 7th Dist.; [5] U. S. Bur. of Labor Statistics; [6] F. W. Dodge Corp.; [7] Fed. Res. Bd.; [8] Ill. Crop Rpts.; [9] Life Ins. Agcy. Manag. Assn.; [10] Ill. Geol. Survey.

[a] August data; comparisons relate to July, 1956, and August, 1955. [b] Seasonally adjusted. n.a. Not available.

UNITED STATES MONTHLY INDEXES

Item	Sept. 1956	Percentage Change from Aug. 1956	Percentage Change from Sept. 1955
	Annual rate in billion $		
Personal income[1]	328.5[a]	+ 0.1	+ 5.6
Manufacturing[1]			
Sales	332.4[a]	+ 0.4	+ 1.8
Inventories	50.1[a,b]	+ 1.2	+12.1
New construction activity[1]			
Private residential	17.0	− 0.4	− 9.3
Private nonresidential	17.1	− 1.1	+ 8.0
Total public	17.1	+ 0.7	+12.5
Foreign trade[1]			
Merchandise exports	18.2[c]	− 6.0	+22.7
Merchandise imports	12.6[c]	− 0.1	+ 9.2
Excess of exports	5.6[c]	−16.9	+69.5
Consumer credit outstanding[2]			
Total credit	40.1[b]	+ 0.5	+10.8
Installment credit	30.7[b]	+ 0.3	+10.8
Business loans[2]	29.7[b]	+ 1.9	+20.5
Cash farm income[3]	n.a.	.....	.....
	Indexes (1947-49 =100)		
Industrial production[2]			
Combined index	144[a]	+ 1.4	+ 1.4
Durable manufactures	163[a]	+ 2.5	+ 1.9
Nondurable manufactures	129[a]	+ 0.8	+ 0.8
Minerals	129[a]	+ 0.8	+ 4.9
Manufacturing employment[4]			
Production workers	105	− 0.7	− 0.8
Factory worker earnings[4]			
Average hours worked	102	+ 0.7	− 1.0
Average hourly earnings	150	+ 1.0	+ 5.3
Average weekly earnings	153	+ 1.8	+ 4.2
Construction contracts awarded[5]	265	− 2.1	− 0.5
Department store sales[2]	129[a]	+ 0.8	+ 6.6
Consumers' price index[4]	117	+ 0.3	+ 1.9
Wholesale prices[4]			
All commodities	115	+ 0.5	+ 3.2
Farm products	90	+ 1.2	+ 1.0
Foods	104	+ 1.4	+ 2.5
Other	123	+ 0.3	+ 3.7
Farm prices[3]			
Received by farmers	87	− 1.1	0.0
Paid by farmers	115	0.0	+ 2.7
Parity ratio	82[d]	0.0	− 2.4

[1] U. S. Dept. of Commerce; [2] Federal Reserve Board; [3] U. S. Dept. of Agriculture; [4] U. S. Bureau of Labor Statistics; [5] F. W. Dodge Corp.

[a] Seasonally adjusted. [b] As of end of month. [c] Data are for August, 1956; comparisons relate to July, 1956, and August, 1955. [d] Based on official indexes, 1910-14 = 100. n.a. Not available.

UNITED STATES WEEKLY BUSINESS STATISTICS

Item	1956 Oct. 20	Oct. 13	Oct. 6	Sept. 29	Sept. 22	1955 Oct. 22
Production:						
Bituminous coal (daily avg.) thous. of short tons	1,747	1,705	1,735	1,752	1,683	1,629
Electric power by utilities mil. of kw-hr	11,333	11,300	11,342	11,365	11,482	10,644
Motor vehicles (Wards) number in thous.	110	91	79	57	50	164
Petroleum (daily avg.) thous. bbl.	6,997	6,993	7,022	7,044	7,063	6,753
Steel 1947-49=100	145	144	145	145	144	138
Freight carloadings thous. of cars	829	823	815	831	822	829
Department store sales 1947-49=100	129	134	127	130	131	133
Commodity prices, wholesale:						
All commodities 1947-49=100	115.2	115.0	115.2	115.2	115.1	111.6[a]
Other than farm products and foods 1947-49=100	123.1	123.0	122.9	122.6	122.6	119.0[a]
22 commodities 1947-49=100	90.7	90.6	91.1	91.8	91.9	89.5
Finance:						
Business loans mil. of dol.	29,836	29,833	29,849	29,724	29,694	25,082
Failures, industrial and commercial number	254	259	253	251	262	239

Source: *Survey of Current Business, Weekly Supplements.*

[a] Monthly index for October, 1955.

RECENT ECONOMIC CHANGES

Record Number of Business Failures

Business failures in the first nine months of 1956 mounted to a postwar high, with approximately one thousand firms closing their doors each month. Average monthly failures in these first nine months were 16 percent more than in the same period of 1955. The largest relative increase, 30 percent, occurred among construction firms. Twenty percent more commercial service firms, 16 percent more trade firms, and 7 percent more manufacturing and mining companies went out of business.

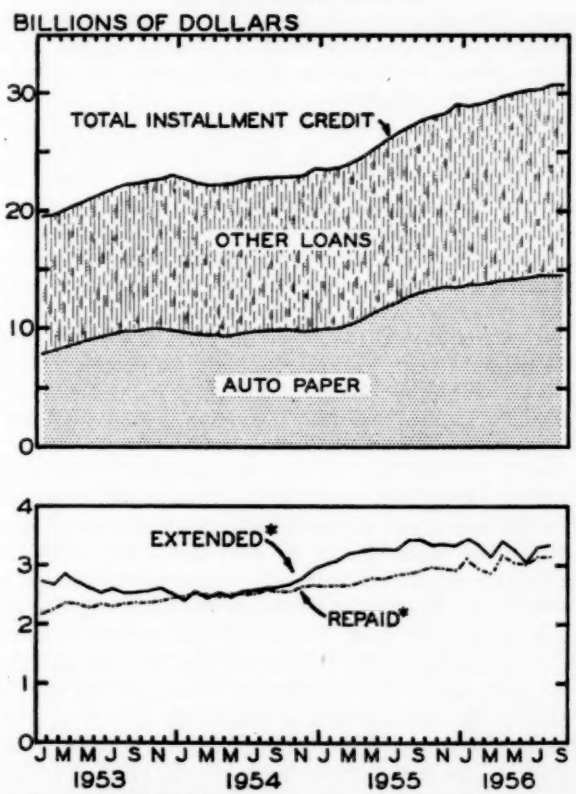
Liabilities of the bankrupt firms averaged $46.9 million a month in the first three quarters. This was up relatively more than the number of failures as liabilities of the average firm increased to $44,000 in 1956 from $41,000 in 1955.

On the other side of the picture, new corporations were being formed at a record rate of 12,000 per month. This was 4 percent above last year and 12 percent above 1946, the previous postwar high.

Installment Debt Expansion Slows

The pace of consumer debt expansion slowed considerably in the first nine months of 1956, as shown by the chart. Between January and the end of September of 1955, total installment debt rose by $4.2 billion. This year the increase during the corresponding period was limited to $1.6 billion. The slowdown in the rate of growth of total installment loans and the narrowing of the gap between extensions and repayments was almost entirely due to reduced consumer demand for automobiles and consequently for auto credit. In the first three quarters of last year such debt advanced by $3.5 billion compared with $1.0 billion this year. On the other hand, non-auto installment debt, led by personal loans, has continued upward at a rate only a little below that of last year.

INSTALLMENT DEBT



* Seasonally adjusted.
Source: Federal Reserve Board.

The credit data shown in the chart are revised estimates of the Federal Reserve Board, appearing in its October *Bulletin*. The principal effect of the revision, which covers the period from 1948, was to raise the estimate of total consumer credit outstanding at the end of 1955 by $2.4 billion. Estimates of all major types of credit were increased except auto paper, which was reduced by the revision.

Liquid Saving Rate Slackens

Individuals reduced their rate of net saving in various forms between the first and second quarters, though this saving was well above the second quarter of last year. In the second quarter of this year net financial claims, as measured by the Securities and Exchange Commission, increased by $2.2 billion compared with $4.8 billion in the first quarter. For the first half of 1956, the increase in net claims amounted to $7.0 billion compared with only $1.3 billion in the corresponding 1955 period, when mortgage and consumer debt increased more rapidly than this year.

The reduction in saving during the second quarter was mainly due to a shift from investment in government bonds amounting to $2.2 billion in the first quarter to moderate liquidation in the second quarter, and an increase in the rate of debt expansion from $2.2 billion to $4.3 billion. Saving in the forms of currency and bank deposits, shares in savings and loan associations, and in both private and government insurance and pension programs continued to rise during the second quarter.

Heavy Corporate Demand for Funds

Corporate demand for funds to finance the record volume of investment in capital facilities and a relatively rapid rate of inventory accumulation in the first half of 1956 totaled almost $18 billion, 5 percent above the first half of 1955, according to an article in the October *Survey of Current Business*. Total outlays for new plant and equipment amounted to $13.6 billion; and if current capital investment intentions for the rest of this year are fulfilled, use of funds for this purpose will exceed 1955 by $5 billion.

Corporations also used $4.2 billion to carry accounts receivable and to finance other miscellaneous outlays in the first half of 1956. Offsetting the increase in fixed and working capital was the liquidation of corporate cash and security holdings to the extent of nearly $8 billion. Much of this movement was seasonal in nature, as corporations drew on their short-term government securities to meet income tax liabilities.

Although internal funds from corporate depreciation reserves and retained profits continued to fill the major part of financial requirements in the first six months of 1956, the unprecedented volume of fixed investment caused firms to seek a larger portion of their financial requirements externally than was the case last year. Corporations increased borrowing from banks and new security issues rose to a record high of $6.2 billion. As a result, internal sources provided only about two-thirds of total requirements in 1956 whereas in the first half of 1955 four-fifths of corporate investment was financed internally.

(Continued on page 8)

AN APPRAISAL OF OPERATIONS RESEARCH TECHNIQUES

JAMES W. PETERSEN
Logistics Department, Rand Corporation

From a basic methodological point of view there is nothing that differentiates operations research, or systems analysis, as it is sometimes called, from any other type of economic analysis. The method is still the scientific method: the analyst must examine a problem and choose the dominant variables, then advance a hypothesis that specifies the relationships between these chosen variables; and finally he must compare his model of reality with the facts to test for consistency. If the analysis is sound it will withstand the acid test of making improved forecasts of future behavior. These steps operations research shares with other kinds of economic analysis.

What sets operations research apart from other traditional social analysis is the attempt to apply this scientific method to new kinds of problems. I hasten to add that the problems are not new; only our attempt to force these matters into a systematic framework of analysis is new. There are many complicated problems whose solutions hitherto depended upon the judgment of some responsible executive. For example, consider the military problem of determining force composition. With a given budget, how should funds be allocated between different types of weapons? Or consider a problem for a business enterprise: What is the optimal amount of inventory to carry and in what form should it be carried — raw materials, semifabricated components, or finished components? Examples are numerous; the point, however, is that in most real situations the decision is made on the basis of rough rule of thumb or informed intuition.

Research May Replace Human Judgment

Even though the intuition of an expert is truly amazing, there is a widespread feeling that judgment could be improved through use of the explicit analysis called operations research. The problems of a decision maker are the very essence of the real world, and to be of value, research cannot abstract too far from reality. For example, to tell a businessman that he should expand output to the point where marginal cost equals marginal revenue is not useful to him unless you work out these measures quantitatively. However, when you try to quantify these things, more and more elements of the real world come into the analysis as independent variables. Naturally, no analysis can take into account all of the elements of the real world, but operations research usually attempts to handle explicitly more variables than traditional economic analysis.

To handle more detailed problems, operations research has had to develop new tools of analysis, for example, mathematical models of varying degrees of sophistication, linear and dynamic programming, theory of games, Monte-Carlo techniques, and others. At the present time we are still feeling our way in the use of these tools. Nevertheless, they are tools, and one might raise the question of how effectively these new research techniques perform their function of providing useful answers.

About three years ago a group was established at the Rand Corporation to work on Air Force logistics problems. In the course of this work we have used just about every research technique available. Today I would like to go back over our experience with you and evaluate the ability of some of these methods to yield useful results.

Analytic Models Aim at Optimal Solutions

Usually the relationships between the numerous variables handled in operations research are difficult to see, and as a result the analyst is forced to develop an explicit, that is, mathematical, model. Models can be of several general types. The first type considered here is the analytic model. Through the operation of this type of model it is possible, at least in concept, to obtain optimal solutions to a problem.

Let me give an example: A common inventory problem requires answering the question, How low should stock levels fall before a reorder is indicated, and once indicated, how much stock should be ordered? The cost of maintaining an inventory equals the expense of holding stock, the cost of not having enough stock, and the cost of replenishing inventory from time to time. The average amount of stock on hand is a function of the reorder point (the amount of stock on hand when a replenishment is indicated) and the reorder quantity (the amount of stock to be ordered once a replenishment is indicated). Expressing the inventory costs in terms of the reorder point and reorder quantity and solving for the minimum cost solution is a relatively simple matter.

Now, this particular model yielded useful results and was used to compute inventory levels in several cases. Note, however, that the model is relatively simple with only two independent variables, the reorder point and reorder quantity. In general, despite the fact that a large number of analytic models were developed, the only ones we have been able to make operational have been simple. In case after case the only use we have made of the more sophisticated models was to publish them in one of the journals where, presumably, they help make life interesting for graduate students.

The fact of the matter is that any non-trivial analytic model, tracing through the full interdependencies of a large number of variables, is going to be difficult and expensive to compute. In the past decade phenomenal advances have been made in the speed and capacity of electronic computers. However, anyone present could put together a model beyond the capability of the most powerful computer available today. Normally, the analyst is forced to cut back the number of variables in his model in the name of computational necessity or economy. When you take a variable out of a model, it cannot simply be dropped; it sneaks back into the study as a part of one of the parameters. This causes trouble.

About a year ago a very complicated procurement model was developed that specified how much stock of a particular spare part should be purchased and when increments of the stock should be delivered. One of the elements in the model turned out to cause serious computing problems, and in order to simplify the analysis, the variable was removed from the model and buried in one of the cost parameters. We had a solution, but not an operational one; we could not obtain a measure of the cost parameter as defined in the model. In any event, this particular model was abandoned when we found that a single solution took a half hour on the IBM 701. Since many thousands of runs were necessary to obtain interesting results, we would quickly have run out of budget.

Complex Models Present Difficulties

Computational difficulties, while very real, are the least of the problems that arise in developing operational models. The more elegant the model, the more refined and accurate must be the input detail. All too often, complicated models call for inputs that are either unobtainable or can only be obtained approximately. To use such models with poor input detail is a waste of time and money.

A few months ago we completed another procurement model which attempted to determine how much of a specific part the Air Force should buy and how orders for the item should be spaced. We used what in concept should turn out to be a very powerful tool of analysis, a dynamic programming model. With this type of model one computes an optimal strategy rather than a single optimal solution. That is, the element of random chance is recognized, and given the situation in any time period the model will specify the course of action most likely to achieve the desired result. If the optimal result is impossible, the model will specify the course of action that will come closest.

This model operates something like this: one starts at the end and specifies the result to be achieved. For example, when the last B-47 is phased out of the Air Force how much of spare part XYZ would one like to have left over? Now working backwards, what level of stock in the preceding time period would most likely allow this goal to be realized? Since the requirement for spare parts is a random variable, there is a range of stock levels each with a different probability of reaching the final goal. Thus one has a range of levels with some chance of attaining the final goal. Going another step back, what level of stock in the preceding time period would allow one to fall within this range of levels in the next to the last time period? And so on, working backward through time. This model is, without a doubt, a very elegant one.

Yet, what did we have? In testing a certain procurement hypothesis, this model could not be made operational; the refined input detail simply did not exist. Reluctantly, we put it back on the shelf and turned to more simple research techniques.

Alternative to an Optimal Solution

It might interest you to know how we eventually tested this procurement hypothesis. First, we gave up trying to determine the theoretically optimal solution, with the rough data obtainable. Second, the analysis was simplified by judicious use of an a fortiori assumption, that is, every simplifying assumption operated against the hypothesis we were testing. We postulated, for example, that the Air Force had the ability and a mechanism to correct procurement errors as soon as they became known. In so large and complex an organization, such an assumption cannot be true. But its effect was that we were testing our hypothesis against the best alternative operations possible in the Air Force system. Finally, we employed sensitivity testing to determine which cost parameters had the greatest impact on the results. If the results were sensitive to a particular cost, we made every effort to obtain the best possible estimate of the cost parameter.

Further, we ascertained how far off our estimate could be and still have pertinent results. In this case, the hypothesis held up over a wide range of costs, and we could prove they were not that high. Hence, although our study did not say this is precisely how far we should go, it did say that we can go at least this far. Thus one can analyze some complicated problems and realize useful results by settling for less than the theoretical optimum.

Most practical work involves very pragmatic types of research problems. While we might like to extend the frontiers of theoretical analysis, most of us face the necessity of producing useful results. This is not to detract from theoretical research. Someday, our data will be more refined and our computational capabilities will be greater. But for now? To date, no one has solved a nontrivial theory of games problem, nor has anyone developed as yet an operational dynamic program model. With very few exceptions (primarily linear programming models) all useful analytic models have been relatively simple. Some of the more elegant of the new research techniques must be viewed with suspicion. Before using them one must be certain that the data and computational ability exist to make them operational. You may be surprised at how few times some of these techniques are applicable.

Monte-Carlo Models

Now I would like to touch briefly on two other types of models. The first of these is the so-called Monte-Carlo model. This model is useful for some problems that cannot be solved any other way. Or, one might use this technique simply because of its educational values.

One of the strong points of the Monte-Carlo method is its ability to cope with uncertainty. Many of the elements in the real world are subject to considerable random variability, and unless this is taken into account an analysis will be incomplete. To illustrate, if I am offered a choice between two bets, one in which I have a 50-50 chance of getting either two dollars or four dollars and another bet in which I have four chances in one hundred of getting one hundred dollars and the rest of the time nothing, which do I choose? The first bet pays an average return of 3 percent, the second pays 4 percent. However, a decision maker cannot make his choice on the basis of average outcome alone. The size of the stakes and the possibility of being completely ruined are also relevant. I would personally not take a bet that on a series of flips of a coin, heads I pay $900, tails I get $1,000, although it is an advantageous bet. The chance of going broke is too great.

While these examples are frivolous, they make the point. Both businessmen and military leaders have to make decisions of this type and cannot ignore the effects of random chance. Random chance is difficult to build into an analytic model, particularly if there are several elements, each subject to chance. In such cases an analyst is forced to go to Monte-Carlo models.

How Monte-Carlo Models Are Used

In concept, a Monte-Carlo model is simplicity itself. One works through each step of the problem applying a randomizing technique to those variables subject to uncertainty. For example, any set of inventory rules must cope with uncertainty. While average demand for inventory may be one per week, actual demand from week to week can vary considerably. Similarly, while the average pipeline time to obtain additional inventory may be one month, there can be many times in which the resupply time differs. In a Monte-Carlo model one ascertains the distribution of such random elements around the average value. Then in working the problem through, one shakes some dice or spins a wheel to determine how much

the demand for a given item will be above or below the average in this time period. Similarly, when a reorder is indicated, one randomizes to determine when the stock ordered will arrive. This is continued through many cycles to obtain expected outcomes. A Monte-Carlo can be worked out by hand; however, an electronic computer is almost essential for useful results. In one of our logistics Monte-Carlo models, we can run through about two centuries of simulated operation in a few minutes with an electronic computer.

A Monte-Carlo model does not give unique or optimal solutions to a problem, but given several likely possibilities, it picks out the best solution of those tested. Monte-Carlo models have certain advantages other than analytic ease. With such a model it is possible to gain a good understanding of variable interrelationships. To determine the effects of variations of a given factor on all other elements of a problem, all the factors but the one to be considered can be frozen and the model run through several times. Concomitant variations can be studied in the same way; all factors but two can be frozen and the effects of variations in these noted.

I have found that if I have an operations research problem that I do not fully grasp, putting it into a simple Monte-Carlo framework usually turns out to be very instructive. Further, since the model simulates the actual steps of the operation, there is a greater likelihood that one will be able to find data in the form in which he wants it. In short, if you have an electronic computer at your disposal, our experience would suggest that this tool of analysis be given consideration.

Gaming Techniques Retain Human Judgment

The last type of model to be discussed is relatively new but looks very promising. It was developed out of military war gaming exercises, and for want of a better name, let me call this new technique a gaming solution.

There was a time when war game exercises were played by individuals alone. A person or team would be in charge of one side (blue forces) and another person or team would take charge of the other (red forces). Each side would be assigned a given force at the start of the game, then they would play war. Red forces might decide to send over a bomber strike and an umpire would use some kind of randomizing instrument to determine what portion of the strike made its objectives.

As time went on, efforts were made to introduce more and more elements of reality into the war exercises until finally the games became too complex to be played by human beings. An effort was made to put all of this detail into electronic computers and essentially have two computers play against each other. This did not turn out to be satisfactory. One of the advantages of the human mind is its ability to change strategy quickly in order to take advantage of chance or of an opponent's mistake. We have not been able to code machines to do this. The most efficient gaming technique developed to date consists of a man-machine combination, wherein the machine stores and handles all of the detail, but at key steps human intervention is possible.

These gaming solutions have proved rather successful in various military problems. At the present time we are in the process of trying to apply this method to military logistics problems. If this attempt should prove successful, the method may be useful on business and economic problems, for, after all, military and business logistics matters have much in common.

Innovation Rules the Boom

(Continued from page 2)

and rising wage rates make the superiority of the new facilities even more evident. The more rapidly wage rates are rising, it is said, the more rapidly existing facilities are made obsolete.

The desire for efficiency has no doubt made an important contribution to the high rate of investment prevailing today, but what remains to be shown is that the situation now differs significantly from similar past situations. Efforts to combat rising costs through increased productivity appear to be characteristic of periods of high prosperity. High rates of innovation, accompanied by increasing productivity and rapidly rising wage rates, in themselves offer no guarantee against a decline. In the prosperity of the late 1920's, all these elements were present. The rise in wages relative to prices was then held to ensure not only the high investment but also the high consumption of the "new era." Neither the investment nor the consumption generated in this way prevented the collapse.

The fact is that most investments not only change the character of productive processes, making them more efficient, but also add to capacity. The higher efficiency of the new plants tends to relieve the squeeze of rising wages on profits. But the growth in capacity puts another kind of squeeze on profits, by increasing the pressure of competition on prices. The way to relieve this pressure is the opposite of the other — that is, it calls for lower investment. In the late stages of the boom, the attempt to apply this alternative sets in motion the cumulative forces of decline; for lower investment means lower demand and makes existing capacity excessive, further restricting the need for new investment. Thus, the innovations that made the boom may be said to rule also over the liquidation of its excesses.

VLB

Recent Economic Changes

(Continued from page 5)

Foreign Aid Rises

The downward trend in United States grants and loans to foreign countries evident since fiscal 1953 was reversed in the year ended June, 1956. Total net grants and credits rose 6 percent to $5 billion. Transfers of military goods and services increased by a half billion dollars to slightly over $3 billion, and other aid was reduced by $200 million during the fiscal year to about $2 billion.

Western Europe continued to receive the major portion of our military assistance — 60 percent in fiscal 1956 — but the increase in such aid to Europe from the previous fiscal year was small compared with an increase of a third to Near Eastern countries, and of a fourth to South Asia and the Far East.

Marked shifts in the geographical distribution of our nonmilitary assistance also took place in fiscal 1956. Disbursements declined sharply in Western Europe, mainly because of reduced payments to France and the United Kingdom in support of their military budgets. As a result, Western Europe's share of total nonmilitary aid dropped from 41 percent in fiscal 1955 to 14 percent in the fiscal year just ended. The share going to the Near East and Africa rose from 17 to 21 percent and that going to other Asian nations rose from 34 to 60 percent.

BUSINESS BRIEFS

PUBLICATIONS AND DEVELOPMENTS OF BUSINESS INTEREST

Women College Graduates

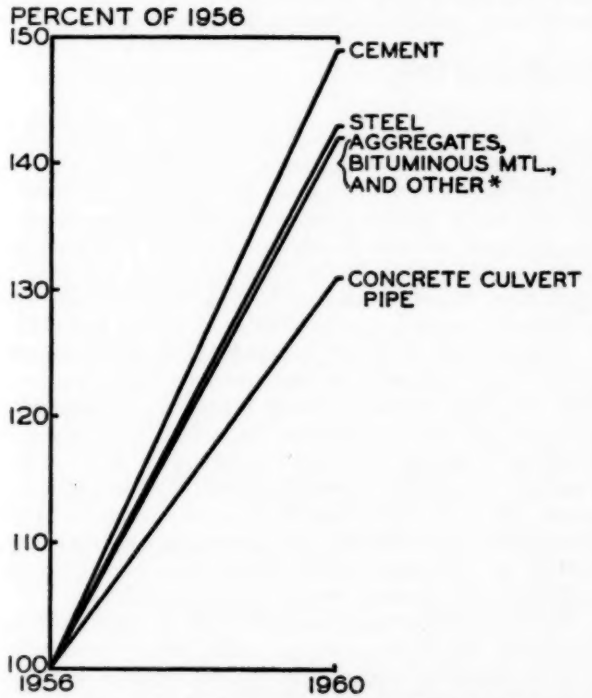
Within six months of graduation, 80 percent of the June, 1955, women college graduates were working. A recent survey of this class six months after graduation, made by the National Vocational Guidance Association and the Women's Bureau of the United States Department of Labor, also indicated that one-third of the class were married. Nearly one-tenth were attending school full time, about 4 percent were seeking work, and 7 percent were neither working nor seeking work.

With widespread shortages of trained personnel, it is important that women college graduates be employed effectively. Fully four-fifths of the working graduates reported a relationship between undergraduate major and first job. Teaching led the occupational list with 61 percent of the employed graduates. This included almost all the employed education majors and at least half the employed graduates who had majored in physical education, English, mathematics, history, music, and home economics. Other groups of employed graduates who showed a relatively high degree of direct relationship between undergraduate major and first job were nurses, biological technicians, chemists, and secretaries.

Highways of the Future

Meeting the needs of the record-breaking $102 billion highway construction program during the next 13 years will require increases of 30 percent or more by 1960 in the production of a number of building materials (see chart). Increases in cement production capacity, which should meet needs, are planned and under way. Wide-flange structural shapes will be the main steel supply problem. If planned capacity increases fail to meet the full demand for this item, reinforced concrete, prestressed concrete, and fabricated plate girders will be used to fill the gap.

ESTIMATED MATERIAL REQUIREMENTS



* Lumber, timber piling, clay pipe and tile, and petroleum products.

Source: U. S. Departments of Commerce and Labor, *Construction Review,* September, 1956.

In computing the material requirements, the Bureau of Public Roads has assumed the maintenance of the 1956 level of state and local government outlays and expansion of regular Federal-aid work from the 1957 level of $825 million to about $950 million. In addition to these amounts, $31.2 billion would be spent under the Federal-Aid Highway Act of 1956. It was also assumed that the total expenditures would increase from approximately $5 billion in 1956 to a peak of about $8 billion in 1960.

Rising Family Income

Median family incomes showed a 6 percent growth in 1955 over 1954, according to a recent Bureau of the Census report. With an estimated median income of $4,420 in 1955 as compared with $4,170 in 1954 and fairly stable prices during this period, a significant gain in buying power for the average family is indicated.

A 7 percent increase over the year in median income of nonfarm families was a contrast to the lack of significant change in rural-farm family income. Stability in rural-farm family incomes, despite lower farm prices, was attributed mainly to increased earnings from nonfarm work.

About one-fifth of the nation's 43 million families received under $2,000, and about two-fifths were in the $2,000 to $5,000 range. The remaining two-fifths received $5,000 or more.

Medical Market Changes

Between 1948 and 1953, prescription sales in the United States rose 16.4 percent. The sales increase, when analyzed by geographical areas, was largest in the Southern, Mountain, and Pacific states. In general, these gains reflected changes in the number of drugstores in various states, in physician movements, and in the pattern of migration of population, especially those in the older age groups.

Prescription sales also varied seasonally, with a high of 20 percent of total prescription sales in the January-February period and a low of 15 percent in the July-August period. Sales volumes by product classifications were relatively stable during the year, with the greatest variations in such highly seasonal products as cough preparations.

Making Farm Work Easier

Four operations in one is the outstanding feature of the "Wonsover" farm machine. This 12-ton vehicle, which is ready for mass production by the Norton Portland Corporation of Portland, Maine, prepares and conditions the soil and plants and covers seeds in one operation. Towed by a tractor and controlled from a panel attached by an extension cord, the machine is said to prepare and seed two to five acres an hour. Selling for about $37,000 fully equipped, the "Wonsover" has bins for seed, lime, fertilizer, and pest and weed killers.

LOCAL ILLINOIS DEVELOPMENTS

With a few notable exceptions, Illinois business activity for September showed little change from August. Steel output made a further increase over August, extending the recovery to an approximate pre-strike level. Declines of more than 5 percent, however, appeared in electric power production, life insurance sales, and bank debits, although only bank debits fell below a year ago. The other banking indicator, business loans, remained almost one-fourth higher than in September, 1955.

Employment Trends

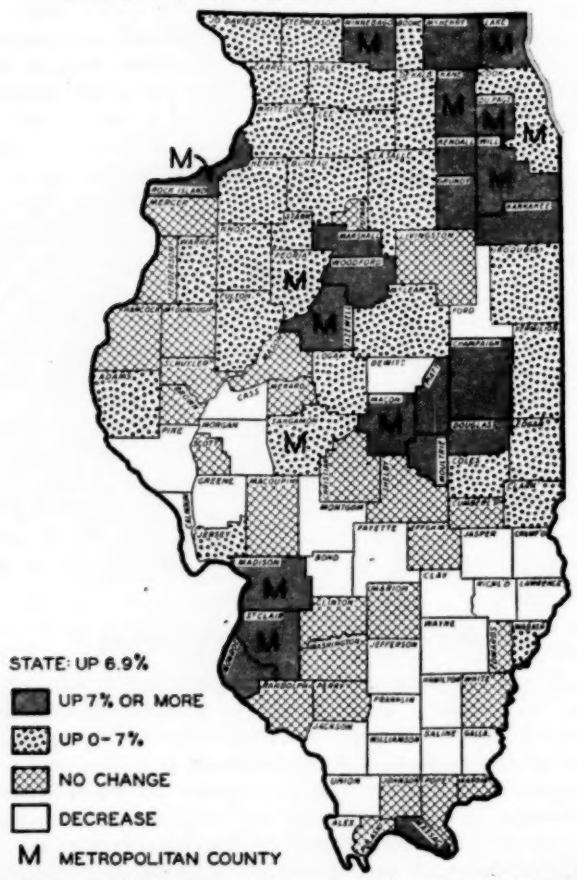
About 3.4 million people were employed in nonagricultural occupations in the State in July. This figure was slightly higher than a year earlier, due mainly to an increase of 43,000 in nonmanufacturing employment to 2.2 million. Employment in construction rose to an all-time high of 204,000. The building of new plants, highways, shopping centers, schools, and homes contributed to this employment rise. During this period, employment expansion also characterized the areas of finance, insurance, real estate, wholesale trade, and communications. Minor reductions were noted in government, retail trade, and transportation employees. Manufacturing employment dipped to 1,240,000, as a result of the steel strike.

A Stitch in Time

An adequate driver education and traffic safety program in our Illinois public schools is less costly than losses resulting from traffic accidents, says Dr. A. E. Florio, Associate Professor of Safety Education at the University of Illinois. In a recent study of economic losses resulting from traffic accidents in Illinois, Dr. Florio estimated that losses in 1955 from the 2,195 traffic fatalities alone amounted to approximately $241.4 million, with an additional $128.6 million loss due to injuries and property damage. In contrast, the estimated total cost of a one-year driver education program for 16-year-old students in the State is about $3.1 million.

Financing of a well-rounded driver education and traffic safety program in public schools should originate from the people benefiting by it, according to Dr. Florio. Suggested sources are $1 increases for drivers' licenses and automobile registration fees.

POPULATION CHANGES, 1950 TO 1955



Source: Illinois Department of Public Health, *Health Statistics Bulletin.*

Our Growing Population

Growth and redistribution characterized the population of Illinois between 1950 and 1955, with an estimated 7 percent increase in the State's population and an even greater growth in the metropolitan and surrounding areas. The State Department of Health reports that about 91 percent of the population increase of 608,000 from 8,753,000 persons in July, 1950, to 9,361,000 persons in July, 1955, was accounted for by the State's 13 metropolitan counties (see chart). These counties had a 9 percent aggregate population increase as compared with the 7 percent State average.

The increased population concentration in metropolitan areas and their immediate environs is indicated by the location of the counties showing percentage increases above the State average. Ten of the 13 metropolitan counties and 12 of the 89 nonmetropolitan counties fell in this category. Of these 22 counties, all except Champaign, Douglas, and Massac were either metropolitan counties or located adjacent to a metropolitan county.

The Missing Link

Illinois may furnish the missing link between the Great Lakes-St. Lawrence Waterway and the Mississippi River System. Development of Port Chicago at Lake Calumet and the widening of the Cal-Sag Channel are the two major projects necessary for the completion of the proposed Illinois Waterway System. The completed system would enable Illinois, the only state with a direct connection between these two large inland waterways, to handle a much larger volume of shipping.

Construction of Port Chicago has begun at the south end of Lake Calumet. In anticipation of possible world-wide shipping channeled from the north by way of the St. Lawrence Seaway and the Great Lakes, plans call for 14 miles of docks capable of handling 25 ships at once, grain elevators with a 13 million bushel capacity, storage sheds able to handle 500,000 tons of overseas or lake merchandise and 200,000 tons of inland waterway barge freight in a 30-week period, and a 13-acre storage tank field for items such as animal and vegetable oils.

The narrow Cal-Sag Channel is the present bottleneck restricting the flow of barge traffic from the south by way of the Mississippi River and the Illinois Waterway System to Lake Calumet. Plans call for widening this channel from 60 feet to 225 feet, replacing bridges which would restrict clearance, and installing adequate control locks.

COMPARATIVE ECONOMIC DATA FOR SELECTED ILLINOIS CITIES

September, 1956

	Building Permits[1] (000)	Electric Power Consumption[2] (000 kwh)	Estimated Retail Sales[3] (000)	Department Store Sales[4]	Bank Debits[4] (000,000)	Postal Receipts[5] (000)
ILLINOIS	$34,932[a]	1,093,882[a]	$585,892[a]		$13,245[a]	$13,626[a]
Percentage change from Aug., 1956	−22.7	+1.3	−0.5	+2	−8.9	+11.7
Percentage change from Sept., 1955	−24.6	+3.6	+3.4	+3	−4.2	
NORTHERN ILLINOIS						
Chicago	$23,615	835,313	$427,910		$11,971	$11,889
Percentage change from Aug., 1956	−32.7	+3.5	−0.8	+3	−9.6	+12.1
Percentage change from Sept., 1955	−15.0	+4.1	+4.6	+2	−4.9	
Aurora	$ 337	n.a.	$ 9,031		$ 61	$ 132
Percentage change from Aug., 1956	−52.2		+4.7	+6	+1.5	+6.8
Percentage change from Sept., 1955	−28.1		+5.3	+9	+10.0	
Elgin	$ 307	n.a.	$ 6,077		$ 41	$ 88
Percentage change from Aug., 1956	−58.8		−4.1	+6	+0.0	+15.6
Percentage change from Sept., 1955	−53.9		−0.5	+7	+14.0	
Joliet	$ 697	n.a.	$12,632		$ 74	$ 98
Percentage change from Aug., 1956	+31.5		+5.7	+6	−4.8	+43.8
Percentage change from Sept., 1955	+7.1		+5.6	+8	+5.6	
Kankakee	$ 223	n.a.	$ 5,142		n.a.	$ 44
Percentage change from Aug., 1956	+64.0		+5.7	n.a.		+16.2
Percentage change from Sept., 1955	−3.0		−7.2			
Rock Island-Moline	$ 781	22,188	$10,341		$ 90[b]	$ 123
Percentage change from Aug., 1956	−61.7	+0.7	+2.7	n.a.	−0.8	−12.6
Percentage change from Sept., 1955	−31.0	+6.6	+4.1		+6.3	
Rockford	$1,721	35,628	$20,070		$ 168	$ 175
Percentage change from Aug., 1956	+42.1	−13.2	−0.3	+6[c]	−4.3	+1.0
Percentage change from Sept., 1955	+66.8	−1.4	+5.3	+12[c]	+5.3	
CENTRAL ILLINOIS						
Bloomington	$ 178	7,672	$ 5,451		$ 62	$ 77
Percentage change from Aug., 1956	−40.1	−5.2	−6.6	n.a.	−5.0	−7.9
Percentage change from Sept., 1955	−84.3	+4.5	−4.2		+0.5	
Champaign-Urbana	$ 349	9,712	$ 7,591		$ 64	$ 85
Percentage change from Aug., 1956	−43.8	−3.7	−12.8	n.a.	+4.1	+14.6
Percentage change from Sept., 1955	−55.4	+0.9	−3.6		+1.6	
Danville	$ 242	11,437	$ 6,423		$ 59	$ 51
Percentage change from Aug., 1956	+26.7	+3.3	−2.2	−5	+10.8	−7.7
Percentage change from Sept., 1955	+28.7	+6.4	−3.0	+10	+13.1	
Decatur	$1,172	31,955	$12,231		$ 122	$ 107
Percentage change from Aug., 1956	+20.0	+3.5	−3.5	−1[c]	+15.4	+19.3
Percentage change from Sept., 1955	−74.0	+4.0	+3.5	+8[c]	+6.9	
Galesburg	$ 194	8,131	$ 4,411		n.a.	$ 28
Percentage change from Aug., 1956	−42.4	−5.1	−0.3	n.a.		+7.7
Percentage change from Sept., 1955	−55.0	+0.6	−2.3			
Peoria	$3,408	53,939[c]	$19,185		$ 208	$ 233
Percentage change from Aug., 1956	+519.6	−0.0	+5.3	−3[c]	−5.4	+17.4
Percentage change from Sept., 1955	+31.6	+1.2	−1.4	+6[c]	−3.1	
Quincy	$ 409	9,675	$ 5,019		$ 37	$ 57
Percentage change from Aug., 1956	+107.6	−4.8	+0.1	−1	−2.3	+13.7
Percentage change from Sept., 1955	−88.1	−5.4	−4.6	−5	−1.2	
Springfield	$ 272	33,381[c]	$14,240		$ 112	$ 189
Percentage change from Aug., 1956	−68.2	−14.7	−1.5	+3[c]	−3.0	−6.3
Percentage change from Sept., 1955	−55.3	+6.7	−1.3	+4[c]	−2.7	
SOUTHERN ILLINOIS						
East St. Louis	$ 723	13,966	$ 9,958		$ 139	$ 179
Percentage change from Aug., 1956	+563.3	−3.7	+2.1	n.a.	−2.5	+38.6
Percentage change from Sept., 1955	+98.6	+2.4	−2.9		+1.0	
Alton	$ 81	12,994	$ 5,333		$ 36	$ 29
Percentage change from Aug., 1956	−65.5	−14.1	+3.5	n.a.	−12.2	+2.8
Percentage change from Sept., 1955	−39.1	−3.6	−2.4		−11.2	
Belleville	$ 223	7,893	$ 4,848		n.a.	$ 41
Percentage change from Aug., 1956	−32.6	−5.9	+4.2	n.a.		+6.0
Percentage change from Sept., 1955	+25.3	+5.2	−4.9			

[a] Total for cities listed. [b] Includes East Moline. [c] Includes immediately surrounding territory. n.a. Not available.

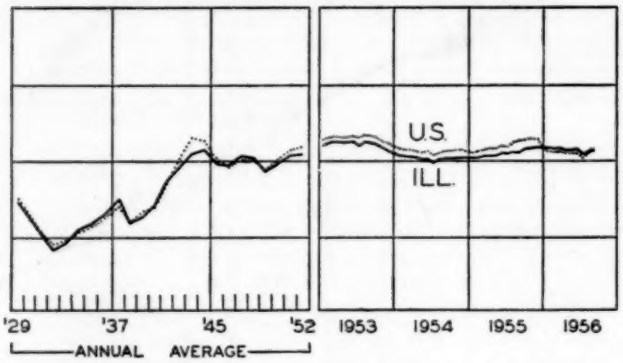
Sources: [1] U. S. Bureau of Labor Statistics. Data include Federal construction projects. [2] Local power companies. [3] Data for June, 1956. Comparisons relate to May, 1956, and June, 1955. [4] Research Departments of Federal Reserve Banks in Seventh (Chicago) and Eighth (St. Louis) Districts. Department store sales percentages rounded by original sources. [5] Local post office reports. Four-week accounting period ending September 21, 1956.

The University of Chicago Libraries
Periodical Division, Harper, M22
Chicago 37, Ill.

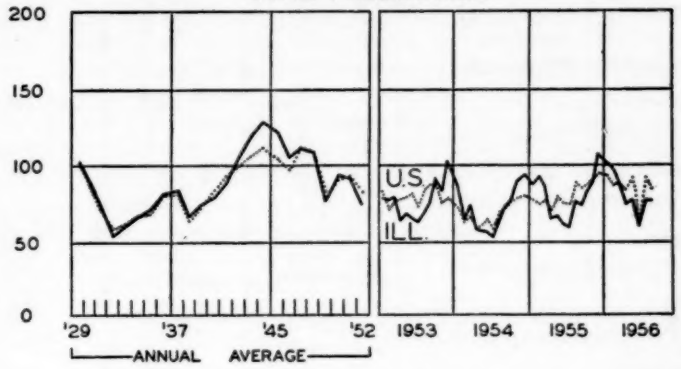
INDEXES OF BUSINESS ACTIVITY

1947-1949 = 100

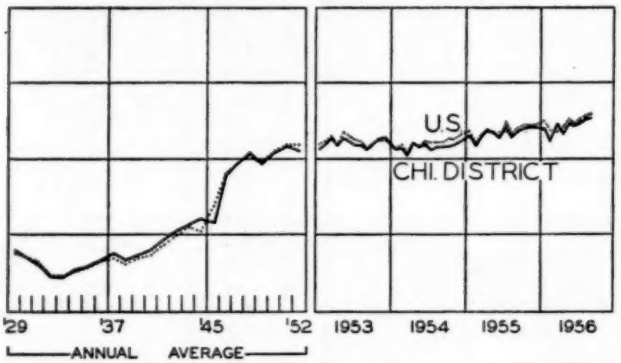
EMPLOYMENT-MANUFACTURING



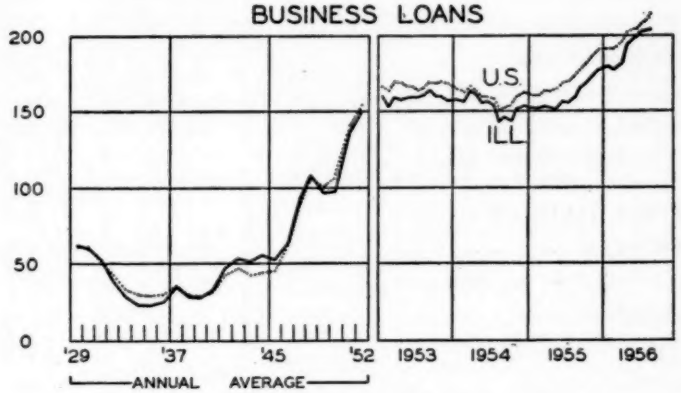
COAL PRODUCTION



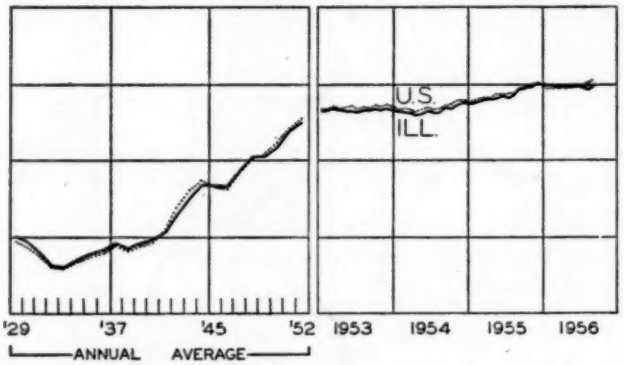
DEPARTMENT STORE SALES



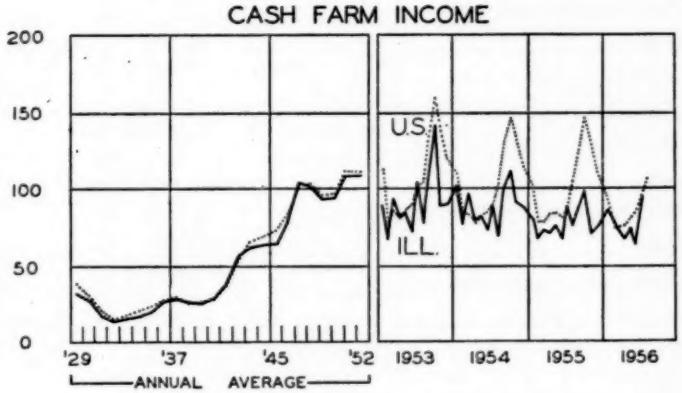
BUSINESS LOANS



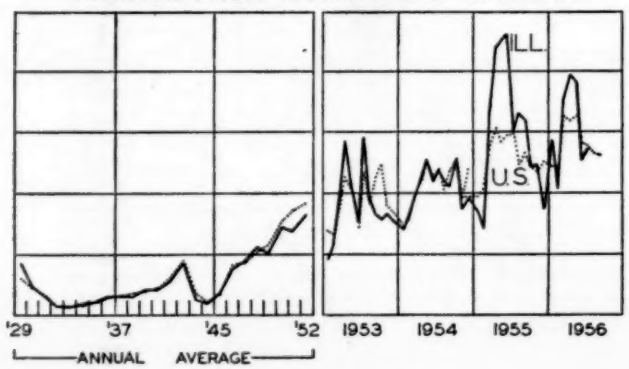
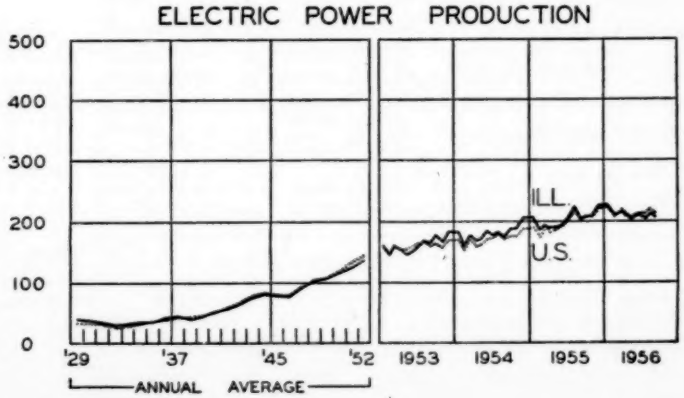
AVG. WKLY. EARNINGS — MANUFACTURING



CASH FARM INCOME



CONSTRUCTION CONTRACTS AWARDED



ELECTRIC POWER PRODUCTION